A N N O T A T E D B R I E F I N G

RAND

Defining Needs and Managing Performance of Engineering Support Services Contracts: Perspectives from the Commercial Aviation Industry

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PREFACE

This Annotated Briefing describes an analysis of commercial practices for managing the performance of aeronautical engineering support services. It is a product of the Project AIR FORCE study, "Supporting the Warfighter Through Improved Service Contracts," sponsored by the Deputy Assistant Secretary for Contracting (SAF/AQC).

Research on services acquisition policy in the Air Force continues in the Resource Management Program of Project AIR FORCE. For additional information or to convey comments on this document, please contact the study leader, Dr. Laura H. Baldwin, at (412) 683-2300 x4901 or at Laura_Baldwin@rand.org.

Readers may also be interested in a related study, *Performance-Based Contracting in the Air Force: A Report on Experiences in the Field*, by John Ausink, Frank Camm, and Charles Cannon, RAND DB-342-AF, 2001, which can be downloaded from RAND's website at http://www.rand.org/publications/DB/DB342/.

Project AIR FORCE

Project AIR FORCE, a division of RAND, is the Air Force federally funded research and development center (FFRDC) for studies and analyses. It provides the Air Force with independent analyses of policy alternatives affecting the development, employment, combat readiness, and support of current and future aerospace forces. Research is performed in four programs: Aerospace Force Development; Manpower, Personnel, and Training; Resource Management; and Strategy and Doctrine.

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SUMMARY

In April 2000, Dr. Jack Gansler, Under Secretary of Defense for Acquisition and Technology, established the goal that at least 50 percent of all service acquisitions, measured in dollars and contracts, should be performance-based by 2005. Air Force interest in performance-based service contracts preceded Dr. Gansler's memorandum. On April 1,1999, the Air Force issued Air Force Instruction (AFI) 63-124, *Performance-Based Service Contracts (PBSC),* which contains guidance on implementing performance-based practices for purchasing a wide range of services to support its installations, employees, and warfighting capability. Under what is now called performance-based services acquisition (PBSA), buyers should (1) describe *what* service is desired and not *how* to do it, (2) use measurable performance standards and quality assurance plans, (3) specify procedures for reductions in fee or price when services do not meet contract requirements, and (4) include performance incentives where appropriate.

Previous RAND research has supported the implementation of PBSA practices in the acquisition of installation support services purchased through operational contracting activities.[1] In March 2001, SAF/AQC asked RAND to expand its research scope to support on-going Air Force efforts to implement PBSA for services purchased by the Air Force Materiel Command (AFMC) that are related to the acquisition and sustainment of weapon systems. A series of interviews with Air Force buyers of such services at an Air Logistics Center and a Product Center highlighted challenges in applying performance-based practices within engineering support services contracts. In particular, personnel found it challenging to construct "measurable performance standards," which some interpreted to require that outcomes be measured objectively and consistently over time and compared to a standard of success that is defined at the beginning of the contract.

SAF/AQC asked RAND to learn how commercial buyers and providers of aeronautical engineering support services apply performance-based practices within their contracts. This Annotated Briefing presents what we learned during a series of telephone interviews with five commercial firms

[1] See Ausink et al (2001a)

that are prominent buyers and/or providers of these services.[2] These interviews took place during Fall 2001.

We found that engineering support services purchased in the commercial aviation industry have similar characteristics to those purchased by the Air Force. Provision of services associated with maintenance and modification activities is governed by regulations that address safety concerns (although the guidelines used by the Air Force may differ from those used in the commercial sector), so how the service is performed is important to the buyer. Many services involve a single end product, with only infrequent opportunities for performance evaluation. Some services address issues for which it is difficult to define a "successful" outcome ex ante and/or lend themselves only to subjective evaluations based on the satisfaction of the buyer. Finally, there can be limited competition for the provision of services. Each of these characteristics can create challenges for applying the performance-based practices the Air Force seeks.

Most firms agreed that buyers are working towards writing SOWs that are output-oriented rather than process-oriented; although many contracts include safety regulations and standards that explicitly address how the work should be completed. Firms indicated that the nature of many engineering support services makes it difficult to fully characterize performance through metrics based on objective data that can be collected consistently over time. Even when such data and metrics are available, they may be misleading when the provider does not control all processes associated with the service. Services for which it is difficult to define success in advance are generally evaluated subjectively. In these cases, buyers prefer to work with providers with which they have long-term relationships. Other services, such as repairs or modifications that require FAA approval for the work, can be measured objectively. However, during the course of the work there are only limited discrete opportunities to measure whether the output met the buyer's needs. Rather than being concerned about such performance measurement issues, firms in our sample rely heavily on communication in managing the performance of their engineering support services contracts. We found variation in the use of contractual incentives. No firms that we talked to had encountered the use of positive incentives in their engineering support services contracts. While negative incentives were sometimes used for services with well-defined objectives, informal incentives based on company reputation were seen as key drivers of performance.

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[2] Assurances of anonymity prevent us from identification of the firms.

The Air Force already employs many of the same practices that commercial firms in our sample use to purchase aeronautical engineering support services. However, there are several commercial practices that we encourage the Air Force to adopt or strengthen to improve their performance and cost outcomes. First, the Air Force could increase its use of award term contracts (that link contract length to performance) for competitively awarded contracts to simulate long-term relationships. Such relationships are viewed as beneficial by the firms we interviewed. Second, rather than focusing on the need for performance metrics based on objective data as a primary tool for managing the performance of engineering support services contracts, the Air Force could benefit from using metrics (based on subjective or objective data, as appropriate) to complement ongoing, intensive communication with its providers. In fact, for some types of engineering support services, better compliance with a strict interpretation of the requirement for "measurable performance standards" may not result in better performance and cost outputs for the Air Force. Finally, the Air Force could strengthen its current communication with providers of engineering support services by increasing the involvement of senior leadership. Our commercial interviews suggest that input from these stakeholders is important to align the provider's actions with the needs of the buyer.

ACKNOWLEDGMENTS

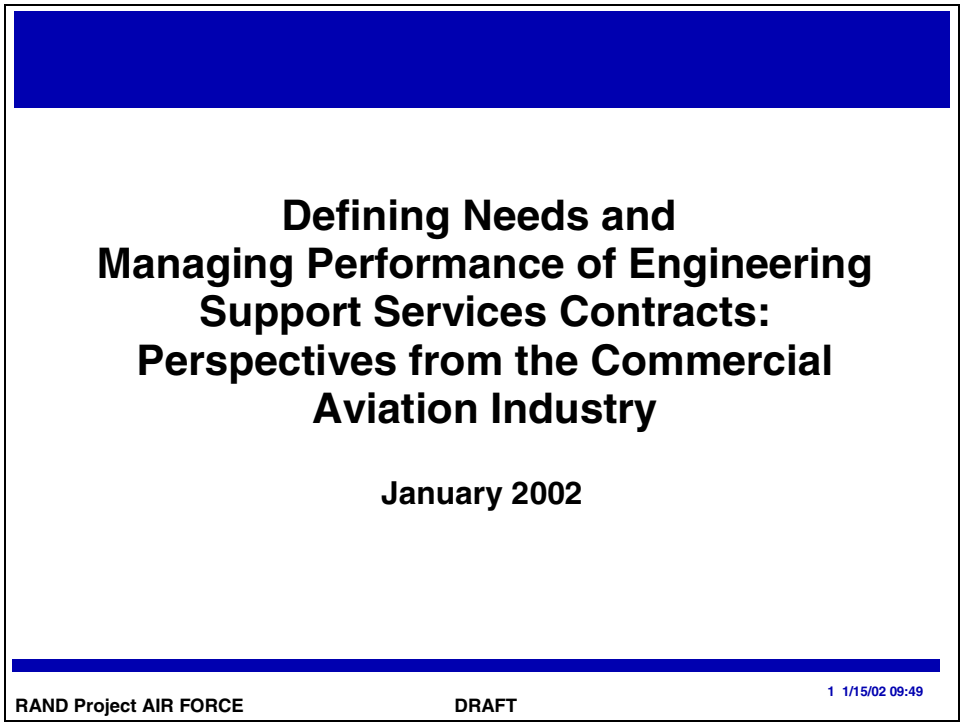
We wish to acknowledge the many employees of the firms that we interviewed who graciously donated their time to help us learn about the application of performance-based practices within their engineering support services contracts. Because of our pledge of confidentiality, we are unable to identify them by name; however, without their help, this research would not have been possible.

Several of our RAND colleagues provided valuable comments and assistance. We thank Bob Roll for his critique of an early draft; Nancy Moore and Charles Lindenblatt for their analyses of Air Force contracts data; and Jean Gebman for clarifying several complex engineering issues. Belinda Greenfield provided valuable document assistance.

ACRONYMS

Acronym	Definition
AFI	Air Force Instruction
AFM	Air Force Manual
AFMC	Air Force Materiel Command
ALC	Air Logistics Center
FAA	Federal Aviation Administration
FAR	Federal Acquisition Regulation
FFRDC	Federally Funded Research and Development Center
OEM	Original Equipment Manufacturer
PBSA	Performance-Based Services Acquisition
PBSC	Performance-Based Service Contract
PEO	Program Executive Officer
PSC	Product/Service Code
RFP	Request for Proposals
SOW	Statement of Work
SPD	System Program Director

1. INTRODUCTION

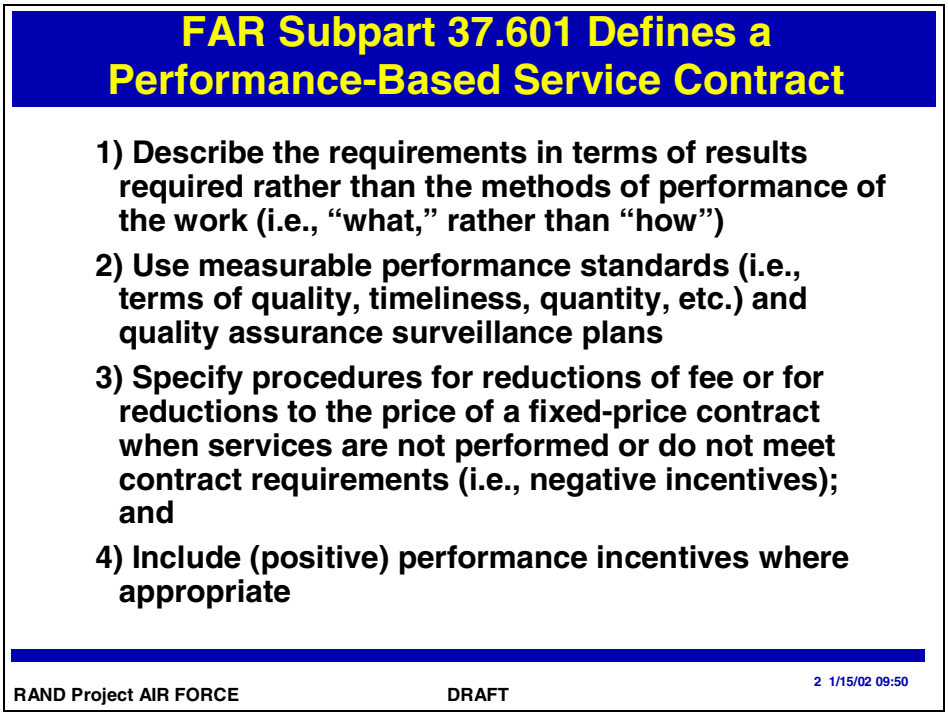


DEFINING NEEDS AND MANAGING PERFORMANCE OF ENGINEERING SUPPORT SERVICES CONTRACTS

During Fall 2001, we conducted a series of telephone interviews with commercial providers and buyers of aeronautical engineering support services to explore the use of performance-based practices in these contracts. The services discussed in these interviews are similar to those purchased by Air Force Air Logistics Centers (ALCs) and Product Centers to support the development, acquisition, and sustainment of weapon systems. This annotated briefing describes our findings.

We promised anonymity to the firms and people we interviewed to encourage them to share their challenges as well as successes and to help them feel comfortable about sharing any relevant proprietary or sensitive information.

We discuss the methodology we used to select these firms in Chapter 2. We believe their experiences represent innovative aviation industry practices for purchasing engineering support services.



FAR SUBPART 37.601 DEFINES A PERFORMANCE-BASED SERVICE CONTRACT

Federal Acquisition Regulation (FAR) Subpart 37.601 gives four requirements for a service contract to be considered performance based:

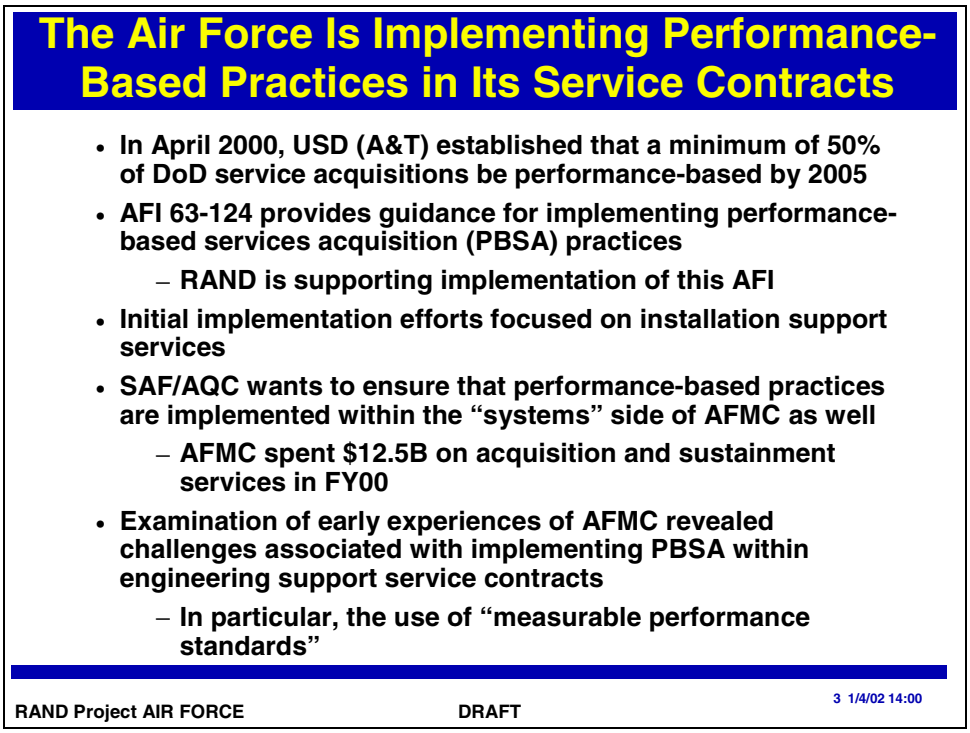
First, the requirements document must reflect *what* the purchaser or user of the services needs, and not *how* the work should be performed.

Second, there should be measurable performance standards and performance thresholds so that the purchaser or user, through the quality assurance surveillance plan, can track performance against clear goals.

The third and fourth requirements for performance-based service contracts tie compensation and other types of benefits to the provider's performance. There should be provisions to reduce fees or the price of fixed-price contracts if services do not meet the purchaser's specified

needs.[3] And performance incentives, such as award fees or award-term contracts, should be used when appropriate.

[3] The Air Force considers the contract clauses 52.246-4 and 52.246-5, which specify re-performance at no additional cost in the event of unsatisfactory work, to satisfy this requirement.



THE AIR FORCE IS IMPLEMENTING PERFORMANCE-BASED PRACTICES IN ITS SERVICE CONTRACTS

On April 5, 2000, Dr. Jack Gansler, the Undersecretary of Defense for Acquisition and Technology, issued a memorandum establishing a requirement that a minimum of 50 percent of DoD service acquisitions, in both dollars and contracts, be performance-based by the year 2005. Performance-based practices are expected to help the Department of Defense improve performance, spur innovation, and increase competition in purchased services, often at a reduced cost to the government.[4]

Air Force efforts to implement performance-based practices preceded Dr. Gansler's memorandum.[5] In 1999, SAF/AQC issued an Air Force

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[4] See Gansler (2000).

[5] However, Air Force efforts appear to have intensified as a result of Gansler's goal. The Air Force issued an implementation plan for performance-based practices in June 2000

Instruction, AFI 63-124, containing guidance for implementing performance-based services acquisition (PBSA) practices.[6] It is based on the FAR Part 37 definition of a performance-based service contract described above.

The Air Force purchases a broad range of services to support its installations, military and civilian employees, and primary warfighting capabilities. Initial Air Force PBSA implementation efforts focused on installation support services purchased through operational contracting activities. RAND's previous and current research supports these implementation efforts.[7] In March 2001, SAF/AQC asked us to expand our research scope to include the services the Air Force Materiel Command (AFMC) purchases to develop and support the Air Force's weapon systems. These services were of interest to SAF/AQC primarily for two reasons. First, AFMC spent over $12.5B on these services in FY 2000, in contrast with $6.5B on services purchased through operational contracting.[8] Second, AFMC was just beginning to implement AFI 63-124 broadly due to delays associated with a union protest.[9] So SAF/AQC was seeking ways to help AFMC move along the learning curve more quickly.

Headquarters AFMC suggested that we visit an ALC and Product Center to learn about the kinds of services purchased and opportunities to apply performance-based practices in these activities. These visits highlighted a

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(U.S. Air Force, June 2000) and began formally tracking the use of performance-based service contracts in October 2000.

[6] See U.S. Air Force (1999). This instruction applies to virtually all Air Force service contracts over $100,000 annually. It is currently in revision under new title, *Performance-Based Services Acquisition (PBSA)*. The revision that the authors have seen includes changes to clarify ambiguities reported by Air Force organizations.

[7] See Ausink, et al (2001a).

[8] These numbers are from an analysis of Air Force data on FY00 contract transactions over $25,000. The Air Force tracks these contracts through the DD Form 350, Individual Contracting Action Report. Service contracts were identified through the Product/Service Code (PSC) associated with each contract. (The PSC for service contracts begins with a letter, rather than a number.) Service contracts were assigned to Air Force organizations based on the office contracting code of the purchasing organization. Services were further classified as related to operation contracting, sustainment activities, or weapon system development by examining the office contracting code, office name, and address. We thank our RAND colleagues, Nancy Moore and Charles Lindenblatt, for creating these classifications and for performing these data analyses.

[9] See Department of Air Force (2000) and Headquarters Air Force Materiel Command Directorate of Contracting (2001).

number of challenges that AFMC faces in applying the FAR definition of a performance-based service contract to some types of services purchased to support the development and sustainment of weapons systems.[10] Establishing "measurable performance standards" was highlighted as a particular challenge, especially for services such as engineering support. These services typically involve analyses to address specific problems, e.g., an aircraft component that experiences malfunctions in icy weather.

Some personnel interpreted the FAR to require frequent collection of objective performance data that allows an ongoing assessment of performance against a known measure of success, i.e., "measurable performance standards" means that you can evaluate the percentage of time the contractor met the performance goal during a certain period of time. It is difficult to apply this definition to many types of engineering support services that the Air Force purchases. For example, it can be difficult to define the successful output of such a service in advance. Sometimes what the buyer asked for turns out to be too difficult based on the current state of technology or too expensive relative to available resources. So evaluation of the provider's performance is often subjective, based on whether the customer was satisfied with the end result or outcome. In addition, although performance is typically tracked on a regular basis, progress for these kinds of services does not necessarily occur smoothly throughout the contract period. Sometimes many alternative approaches must be tested and eliminated before finding one that works. In our minds, these processes do not indicate a failure in performance measurement, but instead are typical for some kinds of cutting edge technological work.

To better understand how to apply performance-based practices within the context of engineering support services, SAF/AQC asked us to learn how commercial firms purchase and manage the performance of contracts for similar types of services. The purpose of this annotated briefing is to:

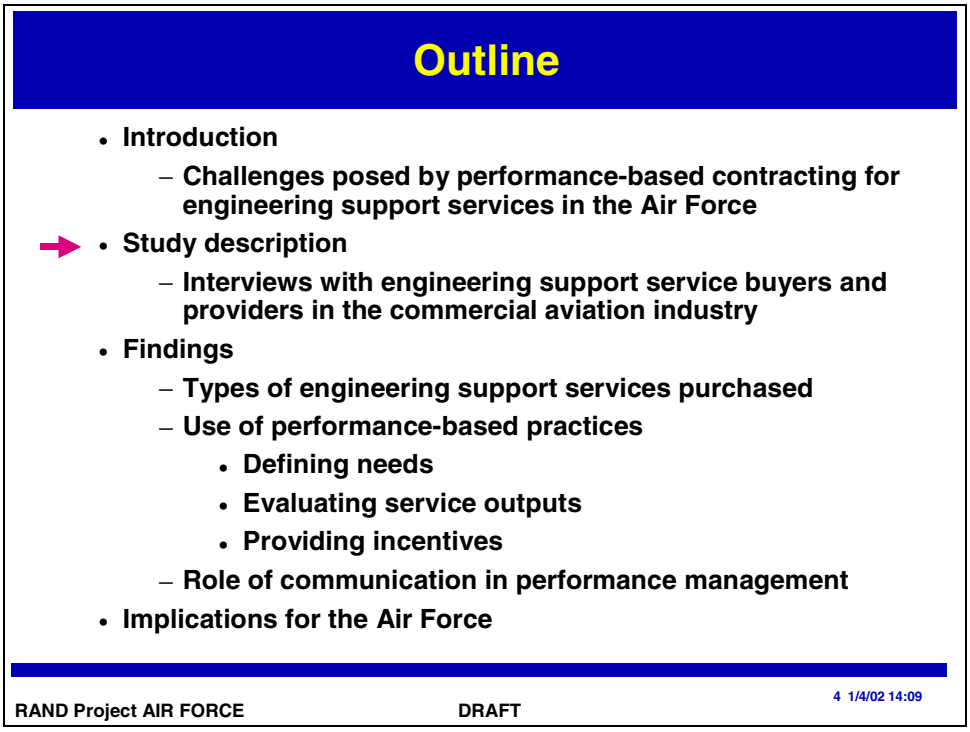
- Describe how commercial buyers of aeronautical engineering support services specify their service requirements and manage the performance of their providers (including through the use of incentives); and

- Draw lessons from these commercial practices to help the Air Force more effectively manage the performance of its

[10] See Ausink, et al (2001b) for complete details about our findings from these interviews.

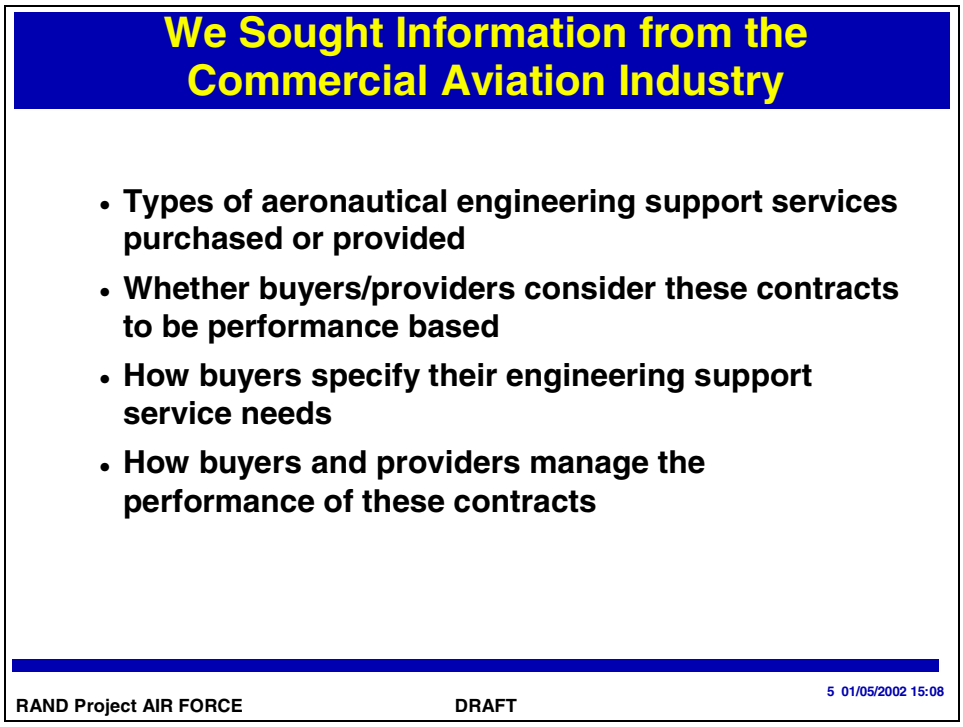
engineering support services contracts to improve service outputs.

2. STUDY DESCRIPTION



OUTLINE OF THE REPORT

The remainder of this annotated briefing is organized as follows. In this chapter, we describe our study methodology, including the selection of firms and the personnel interviewed. In Chapter Three, we discuss our findings. We describe the kinds of engineering support services discussed in our interviews and how the firms apply performance-based practices within these contracts. We conclude in Chapter Four with a comparison of commercial and Air Force practices and implications for the Air Force's implementation of AFI 63-124 for engineering support services contracts. In the Appendix, we provide the interview protocols that we used to guide our discussions with commercial firms.



WE SOUGHT INFORMATION FROM THE COMMERCIAL AVIATION INDUSTRY

We conducted hour-long interviews using a focused interview protocol to guide our discussions. Please see the Appendix for details about our interview protocol. We addressed four main topics in these interviews.

We began each interview with a description of the purpose of our study, which included the FAR Part 37 definition of a performance-based service contract. After learning about the types of engineering support services that the firm buys or provides, we asked whether they consider their contracts for engineering support services to be performance based. This provided a foundation for the rest of the discussion.

Next, we sought information about how buyers convey their engineering support service needs to providers.

Finally, we examined how buyers and providers manage the performance of these services, including how buyers evaluate provider performance, how buyers and providers communicate about progress and performance,

and how buyers motivate improvements in performance. We asked about the personnel who are involved in these performance management activities as well as the processes used.

WE SELECTED FIVE FIRMS FOR INTERVIEWS

We conducted interviews with representatives of five commercial firms in the aviation industry.

Three of the firms that we interviewed were major airlines with significant in-house engineering expertise. In addition to supporting their own fleets, each of these airlines provides aircraft maintenance services, including engineering support services, to other commercial aircraft operators.

One of these airlines spoke to us about the specialized engineering support services that it purchases, as well as the services that it provides to others. Interestingly, this firm maintains an internal "firewall" between its provider and buyer activities. We talked to representatives from both sides separately, and these interviews represent two different data points.

The fourth firm was a third-party provider of comprehensive aircraft maintenance and modification services.

The fifth firm was an original equipment manufacturer (OEM). Although this firm has an in-house engineering capability, it purchases selected

engineering services to support its development activities. Our discussion was from the buyer's perspective rather than the provider's perspective.

We selected these firms because of their prominence within the aviation industry. As a result, we believe that the purchasing practices used by these firms in their engineering support services contracts represent innovative industry practices.[11] We hope to have an opportunity to build on this analysis by conducting a second round of interviews that would include buyers associated with the providers we interviewed in this first round,[12] as well as well-respected providers of specialized engineering support services, known as "niche" players within the industry.

In our conversations with providers that have both commercial and government contracts, we focused on their experiences working with commercial buyers.

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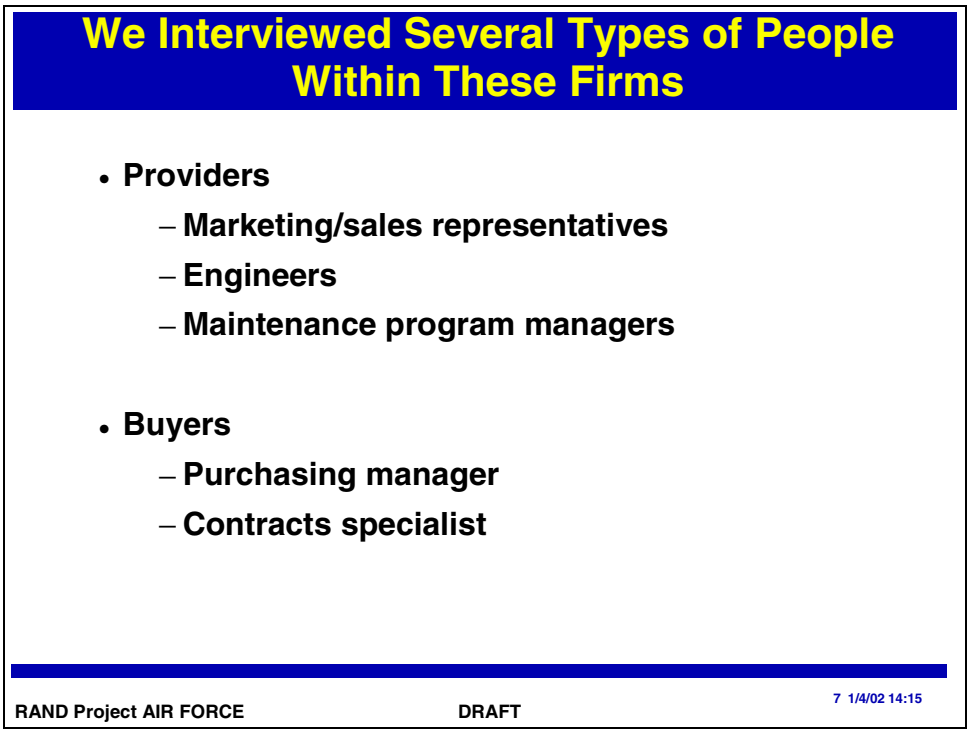
[11] The similarity of responses across interviewees was surprising, given the size of our sample. This led us to believe the sample was large enough to accurately capture practices within this sector of the aeronautical engineering industry.

[12] There are two categories of primary buyers of services from the providers we interviewed: cargo carriers and airlines that are not large enough to maintain a large in-house engineering capability.



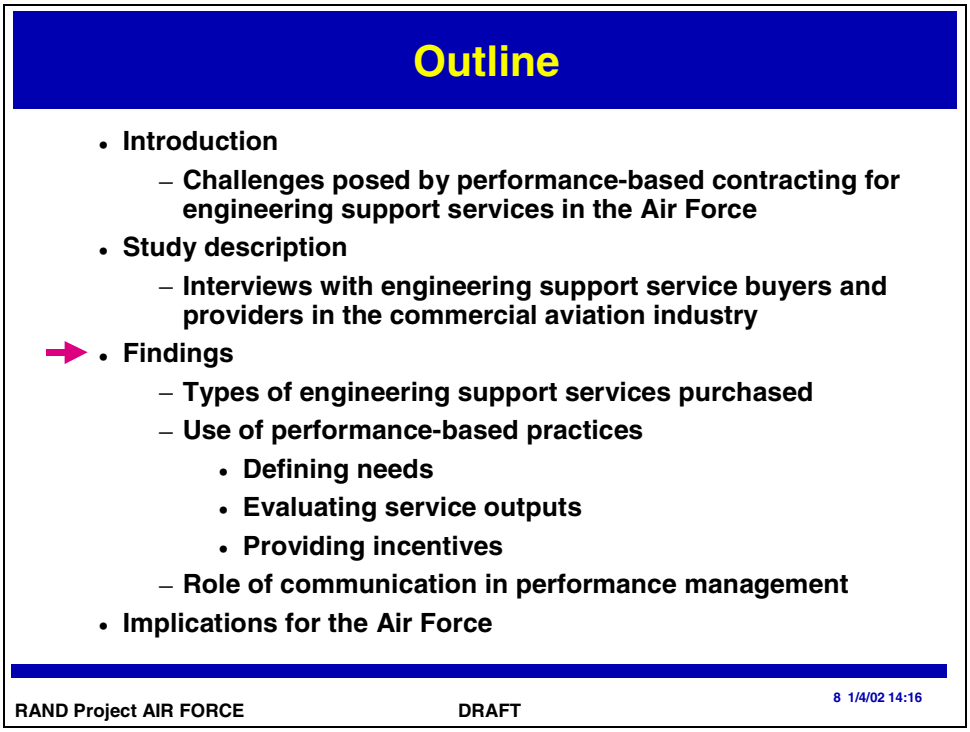
WE INTERVIEWED SEVERAL TYPES OF PEOPLE WITHIN THESE FIRMS

We had opportunities to talk with several different types of people involved in the process of providing and purchasing engineering support services within the firms in our sample.

For each of the four service providers, we spoke with one or more of the following types of people: (1) marketing or sales representatives who work with buyers (both new and existing clients) to determine their needs and then work with the experts within their own organization to ensure that those needs are met, (2) engineers who provide the technical expertise within the engineering support services contracts, and (3) maintenance program managers who directly manage workload for buyers.

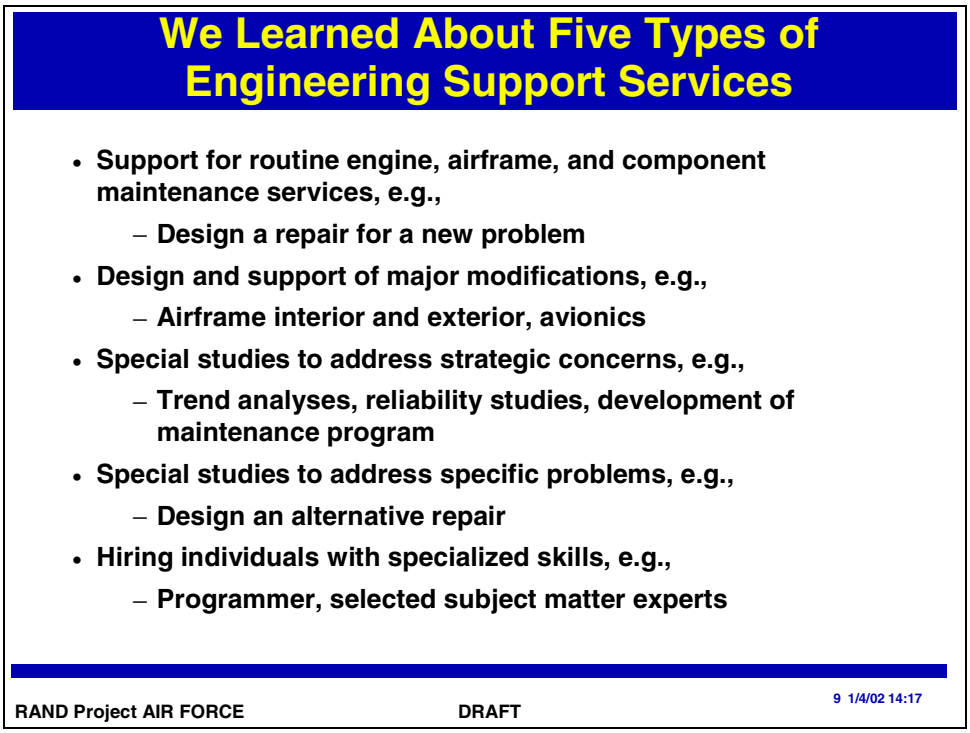
On the buyer side, we interviewed a purchasing manager who leads sourcing activities associated with a particular aircraft subsystem and a contracts specialist who assists internal consumers of engineering support services in their purchases of these services.

3. FINDINGS



OUTLINE OF THE REPORT

In this chapter, we discuss our analysis of information gathered through our interviews. We begin with a description of the types of engineering support services purchased and provided by the firms we interviewed. We then describe the use of performance-based practices in these firms' engineering support services contracts. Finally, we describe how buyers and providers communicate with one another to ensure that purchased engineering support services meet buyers' needs.



WE LEARNED ABOUT FIVE TYPES OF ENGINEERING SUPPORT SERVICES

The firms that we interviewed purchase and provide a wide range of engineering support services. We have grouped these services into five categories.

Each of the providers we spoke with offers engineering support services associated with routine aircraft maintenance, such as engine overhauls, airframe heavy maintenance,[13] and component repair. (The airline buyer that we talked to also purchases maintenance for some of its engines.) Engineering support is needed when maintenance technicians discover a problem that has not been addressed before, such as a crack in an unusual area of a bulkhead. In these cases, engineers are asked to figure out the appropriate action—i.e., repair (how), replace, or wait until the next scheduled maintenance to take action—to ensure the aircraft will remain

[13] Routine airframe maintenance for commercial aircraft is conducted through "letter checks". The C-check is analogous to programmed depot maintenance for most Air Force aircraft weapon systems.

safe to fly until the next scheduled maintenance. Routine maintenance is typically purchased through fixed price contracts,[14] which include a certain amount of engineering support. If difficulties arise that require engineering support above the budgeted level, then the buyer pays for these services through a cost-based contract,[15] with a fixed wage rate.

Two of the providers in our sample offer major modification services for changes and additions to airframes and avionics, which require a great deal of engineering expertise. Examples include moving a galley (i.e., kitchen) so that the floor plan of a newly acquired aircraft matches the rest of an airline's fleet and adding an emergency door, a total collision avoidance system, or a glass cockpit. These services can include designing the modification, testing the modification, obtaining a Federal Aviation Administration (FAA) supplemental type certificate for the change, creating technical guidelines for installation, performing the installation, and providing engineering support once the modified planes are back in service. The modifications we discussed are typically purchased through stand-alone, fixed price contracts.

A third type of engineering support service that we heard about is special studies to address buyers' strategic issues. We discussed these with two of the providers we interviewed. Such studies include monitoring engine operational data (e.g., temperature, gas and oil pressure) to anticipate future maintenance requirements, performing trend analyses of maintenance or availability data, and developing a maintenance program for a new airline or an airline that has acquired a new type of aircraft (which can include acquiring FAA approval for the new program and providing training for maintenance personnel).

A fourth type of engineering support service that was discussed is special studies to address specific problems encountered by aircraft operators that occur outside of routine maintenance activities. Both buyers in our sample purchase these services, and three of the four providers offer them. As examples, aircraft operators may seek alternative repair strategies to address FAA airworthiness directives or may contract with engineering firms to reverse-engineer parts so that they can avoid buying them from OEMs. In addition, we heard from the OEM that occasionally

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[14] In a firm fixed price contract, the price the buyers pays for the service is not adjusted based on the cost the provider incurs in providing the service.

[15] In a cost-based contract, the price the buyer pays for the service is directly linked to the cost the provider incurs in providing the service.

it seeks advice about whether particular parts can be redesigned to facilitate the manufacturing process.

Each of the types of special engineering studies mentioned above is usually purchased through stand-alone contracts. If the workload is fairly well defined, fixed price contracts are used. Otherwise, cost-based contracts are preferred; however buyers may place limits on the total level of effort.[16]

Finally, as a fifth type of engineering support service, the two buyers in our sample hire engineers with specialized skills on short-term bases to perform specific activities. For example, the airline hires engineers who can do specialized types of testing and software engineers for programming projects associated with engines. The OEM hires aeronautical engineers with expertise in areas such as composite materials.[17] These buyers have made strategic decisions not to maintain these particular types of expertise in-house. This type of engineering support is usually purchased through cost-based contracts in which the expert is paid by the hour.

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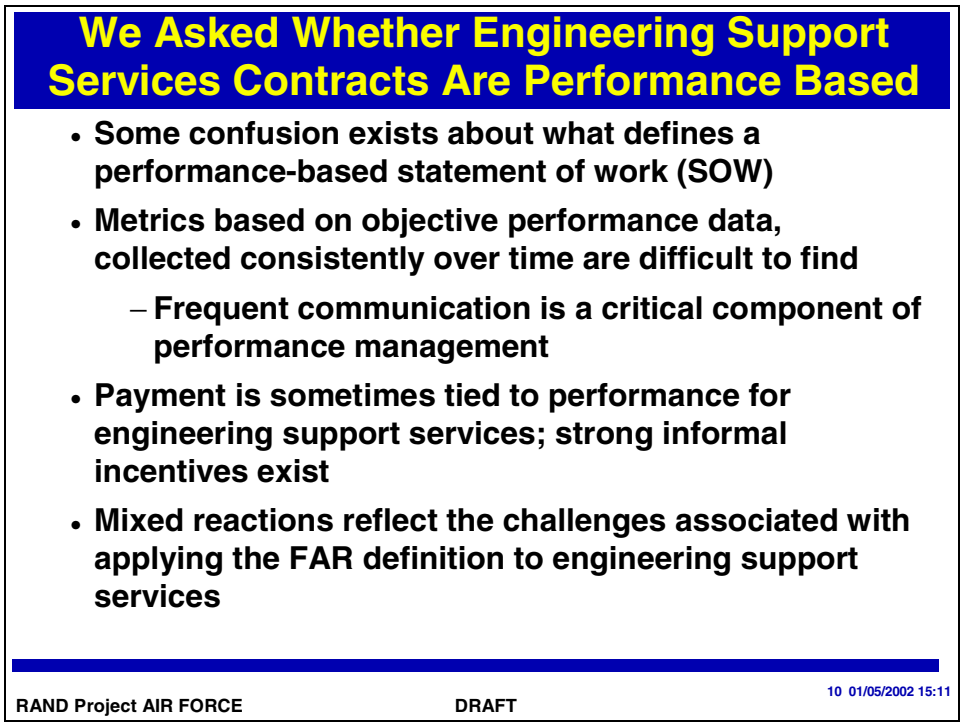
[16] One of the airline providers indicated that buyers that purchase comprehensive support (including all aspects of routine maintenance and special studies) from a single provider, instead of only several small services (e.g., engineering services, trend analyses), benefit from the resulting integration of these related services.

[17] This buyer told us that because of the specialized nature of the work, often there are only one or two people in the country who are qualified. Thus, these contracts are rarely bid competitively.



WE ASKED WHETHER ENGINEERING SUPPORT SERVICES CONTRACTS ARE PERFORMANCE BASED

After those we interviewed explained the types of engineering support services they provide or buy, we asked them whether they thought their contracts for these services were performance based. In each case, we explained the four-part FAR definition of a performance-based service contract so that their responses were aligned with the practices of interest to the Air Force.

In terms of the first part of the FAR definition, there were differences of opinion among those in our sample as to whether their statements of work (SOWs) were performance based. Although most agreed that they are working towards writing SOWs that are output-oriented rather than process-oriented, many contracts still include safety regulations and standards which explicitly address how the work should be completed. For the most part though, those in our sample agreed that their contracts focused on service outputs, and at least for some of the types of services that were discussed (e.g., a reliability study, designing a new maintenance program), buyers did not specify how to do the work in the SOW.

In terms of the second part of the FAR definition, firms indicated that the nature of many engineering support services makes it difficult to find performance metrics based on objective data that can be collected consistently over time. This is similar to the concerns we had heard from Air Force personnel in their interpretation of the second part of the FAR definition requiring the use of "measurable performance standards".[18] Sometimes desired end results of services are difficult to define when the contract is designed, e.g., when asking a firm to determine whether there is a cost-effective way to redesign a part or hiring an expert to provide advice about a technical challenge. In these cases, performance is evaluated subjectively. For other services, such as designing a modification or a new repair, ultimate success can be evaluated by whether the provider achieved FAA approval for the work by a specific date. These can be measured objectively; although there often are limited opportunities to measure whether the output met the buyer's needs. However, we learned that rather than being concerned about such performance measurement issues, our sample relies heavily on communication in managing the performance of engineering support services contracts.

In terms of the third and fourth parts of the FAR definition of a performance-based service contract (i.e., the use of positive and negative incentives), we found variation in the use of contractual incentives for engineering support services among the firms we interviewed. While negative incentives were sometimes used for contracts with well-defined objectives, we learned that informal incentives based on company reputation were seen as key drivers of performance.

In sum, we heard mixed reactions to our question about whether engineering support services contracts were performance based, as defined by the FAR. These reactions mirror the challenges that we learned about during our recent visits to an Air Force ALC and a Product Center. In the following charts, we describe these challenges in more detail, with specific examples from our commercial interviews.

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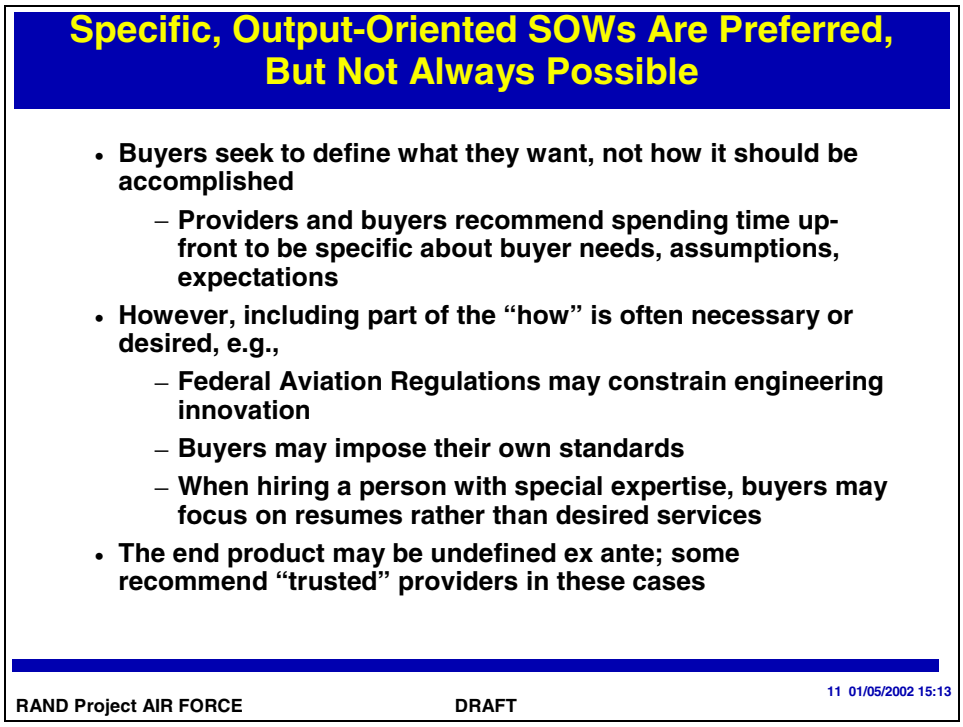
[18] See Ausink, et al (2001b).



SPECIFIC, OUTPUT-ORIENTED SOWS ARE PREFERRED, BUT NOT ALWAYS POSSIBLE

Across the board, we heard that buyers in the commercial world are interested in writing their SOWs in terms of what they want, not how the work should be accomplished. Firms we interviewed said that in order to achieve this goal, it was critical for the buyer and provider to spend time up-front, before the contract is written, to discuss buyer needs and the assumptions and expectations of the buyer and provider. In some cases, this may lead to the provider giving input to the formal request for proposals (RFP), including the definitions of milestones and the schedule.

However, we were told that sometimes SOWs for engineering support service contracts do include the "how". For many engineering support services related to aircraft maintenance or modification, the work must satisfy Federal Aviation Regulations.[19] One provider discussed an example of the design, installation, and support of an emergency door

[19] For more details, please see the FAA website: www.faa.gov.

modification. The buyer was not interested in how the work was done, as long as it met FAA approval allowing them to increase their passenger capacity. Federal Aviation Regulations governed many aspects of the work, including the spacing of the door and the evacuation system; however, the provider was able to determine the design of the door, slides, and interfaces, subject to satisfying those regulations. For services associated with aircraft heavy maintenance, the buyer may supplement Federal Aviation Regulations to create their own more stringent requirements that service providers must meet. In addition, for special studies that involve data entry, buyers may specify the format of the data so that the end product will be compatible with their existing systems. And finally, when writing a contract to hire individuals with a special expertise, buyers sometimes focus on resumes, to ensure they get access to the right capabilities, rather than the output expected by the individual.

As discussed above, sometimes it is challenging for buyers to tell providers what they want because the nature of the end product is difficult to describe in advance. In these cases, buyers rely heavily on providers that they trust and with whom they have long-standing relationships.[20]

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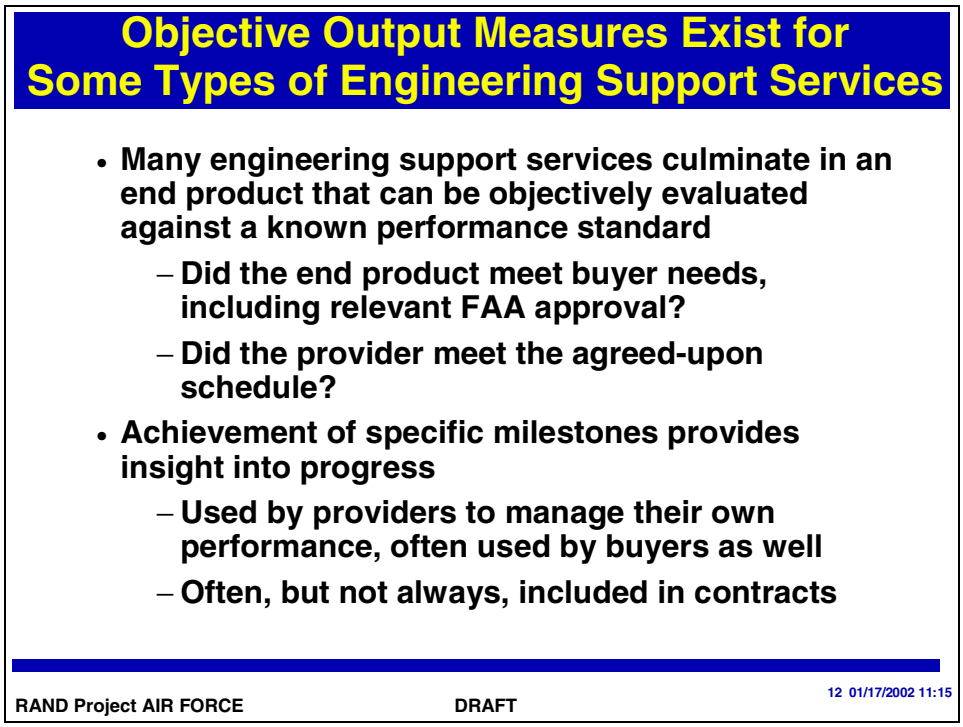
[20] The OEM that we spoke with described a rigorous process that it uses to qualify engineering support service providers as "key" providers. The OEM sends a team of engineers to visit providers' organizations to examine particular capabilities. Providers that satisfy this OEM's criteria are then approved to perform specific types of engineering work, depending on their areas of expertise.



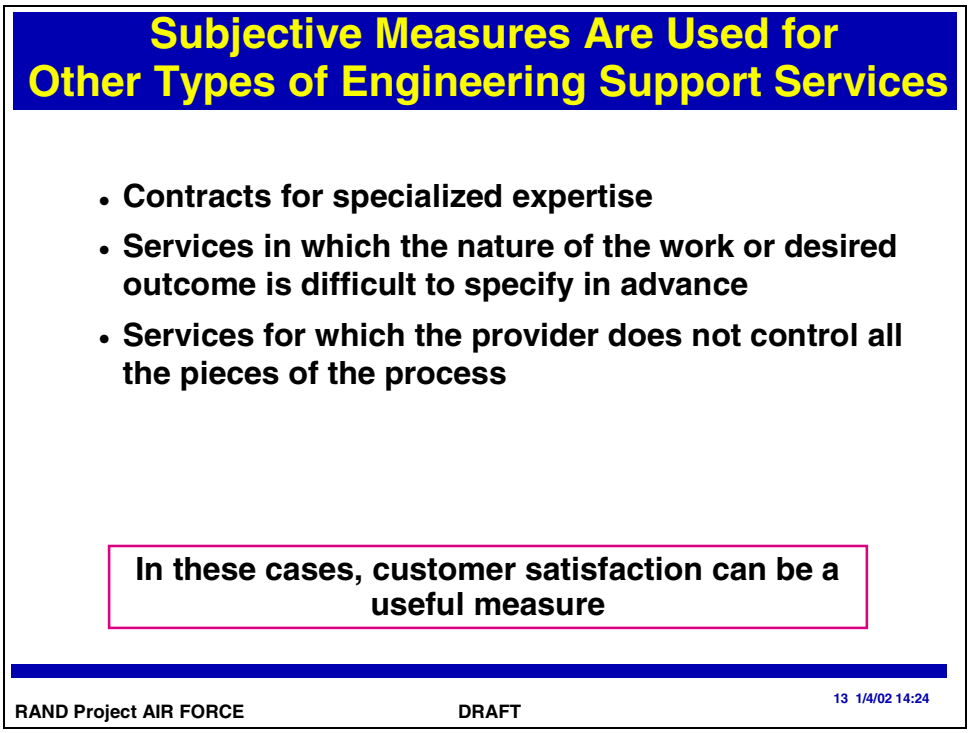
OBJECTIVE OUTPUT MEASURES EXIST FOR SOME TYPES OF ENGINEERING SUPPORT SERVICES

Firms in our sample agreed that many times a provider's performance can be objectively evaluated against a known performance standard. As discussed earlier, many engineering support services related to aircraft maintenance and modifications result in an end product that must be approved by the FAA. In these cases, providers and buyers agree up-front on a reasonable schedule for completing the work and achieving the appropriate approval. Then achieving approval by the specified date is an output-oriented performance metric that buyers can use to evaluate the ultimate performance of their providers.

To manage performance of complex engineering support services, providers and buyers in our sample use performance metrics that are tied to major milestones (or incremental outputs) for the work. For the design of a major modification such as moving a galley or adding an emergency exit door, milestones might include completion of a certification plan, engineering drawings and instructions, completion of the FAA approval paperwork, certification of the instructions, and inspections during the

initial installation. For design of a maintenance program for a newly acquired fleet, milestones might include completing the maintenance plan, gaining regulatory approval, and training maintenance workers. These milestones are often, but not always, written into the contract. Performance can then be evaluated throughout the contract as the provider approaches each of the major milestones.

One provider in our sample uses a set of internal milestones and metrics to manage its own performance. It typically shares these with the buyer to communicate progress. But more importantly, it relies on these to ensure that its own performance is on target. The interviewee said that maintaining the schedule was critical to the company's success.



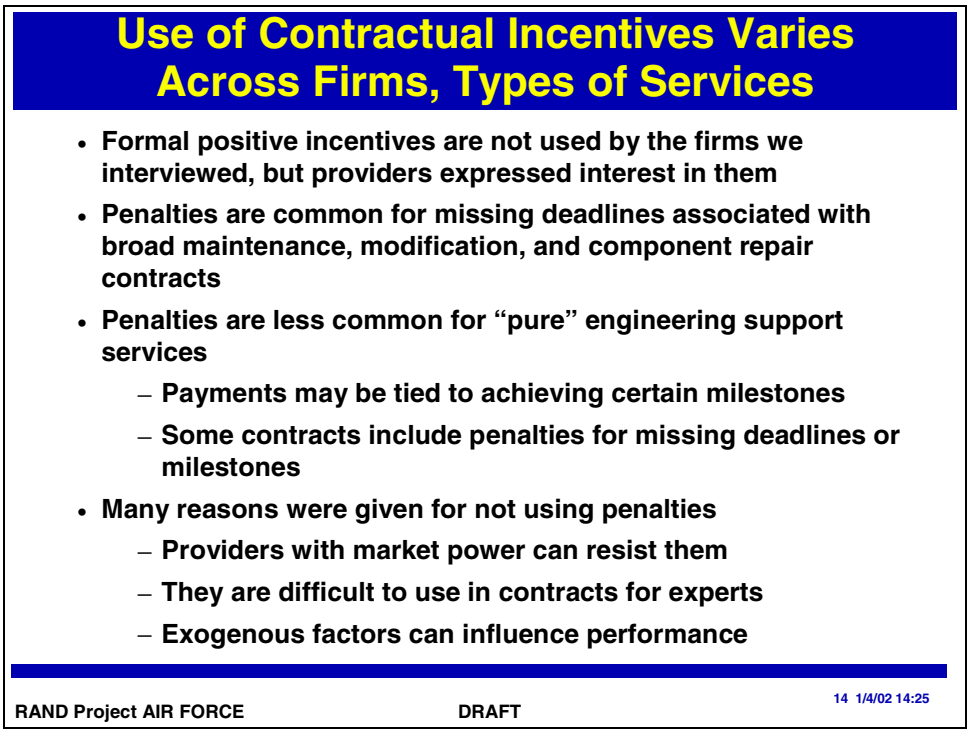
SUBJECTIVE MEASURES ARE USED FOR OTHER TYPES OF ENGINEERING SUPPORT SERVICES

For other types of engineering support services discussed in our interviews, buyers and providers in our sample found it difficult to define end products and objectively measure performance. For example, when hiring an expert with special skills to help address a problem associated with developing a new aircraft system or contracting with a provider to perform an analysis of a reported production problem, the exact nature of the work, and even what would define a successful end product, may not be known at the beginning of the contract. Thus it is difficult for a buyer to come up with a standard against which the provider's performance can be evaluated.

In addition, sometimes a provider does not control all the inputs or processes associated with a service. For example, when performing an analysis of engine data to forecast maintenance needs or create a preventive maintenance schedule, the provider relies on operational data supplied by the buyer. If these data are not supplied in a timely manner,

the provider may be unable to meet the buyer's desired schedule for the analysis. Similarly, when designing a repair or another procedure to increase reliability, ultimate performance may be influenced by exogenous factors that include usage by the buyer. In these cases, it can be misleading to evaluate the provider against a performance measure such as meeting the schedule or mean time between failure.

To address these challenges, buyers rely on frequent interactions with providers to understand and assess their activities. Subjective measures such as customer satisfaction ratings can be a useful way to communicate provider performance. We will return to the role that communication plays in the performance management process later in this chapter.



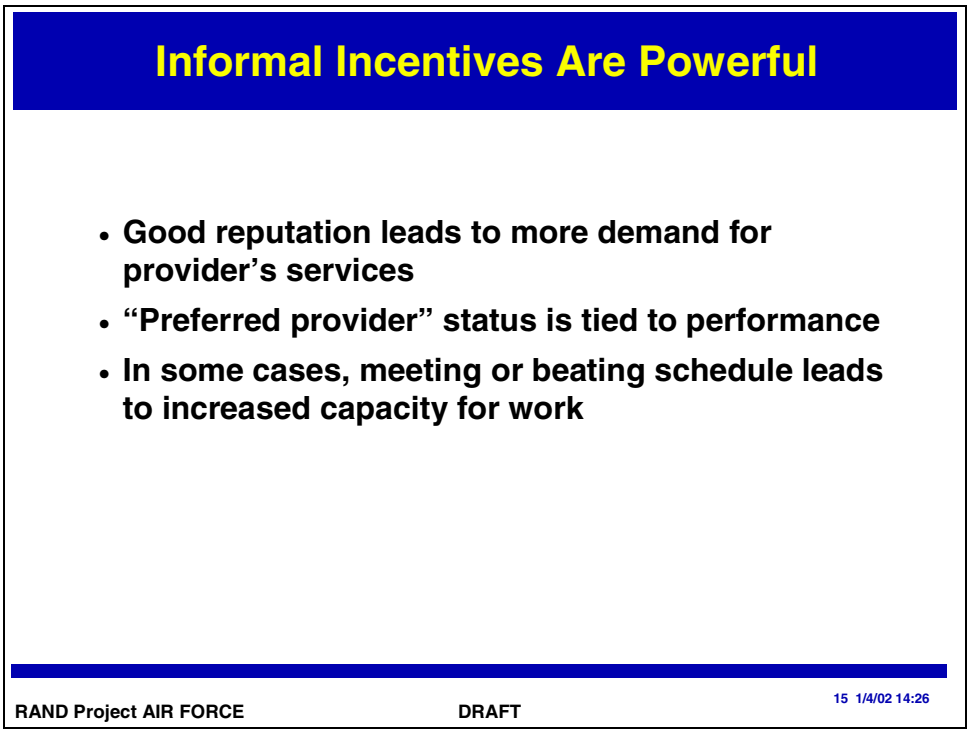
USE OF CONTRACTUAL INCENTIVES VARIES ACROSS FIRMS, TYPES OF SERVICES

We had anticipated that we would observe variation in the use of contractual incentives across the firms in our sample and types of engineering support services. Our intuition suggested that formal incentives would more likely be used for services that are easy to evaluate through objective performance measures. However, we were surprised to learn that none of the firms we interviewed use positive incentives, although providers expressed interest in them. In contrast, negative incentives, or penalties, were commonly reported for missing deadlines associated with broad maintenance, modification, and component repair contracts. One provider of engine maintenance services said that it pays a penalty for each day it is late returning an engine. In addition, if an aircraft is grounded as a result, the provider must lease an engine or provide a spare.

Formal incentives were less common in contracts for pure engineering support services (i.e., services not associated with other types of maintenance or modification activities) such as design of major

modifications, special studies, and hiring individuals with specialized skills. In some cases, payments were tied to achievement of milestones, such as gaining FAA approval for a modification design. We also heard that payment can be tied to 50% and 100% completion. In addition, some contracts included penalties for missing deadlines or milestones.

Many reasons were given for the relative lack of penalties. One provider in our sample indicated that it does not need to accept contracts that include penalties. Similarly, a buyer indicated that OEMs with market power can resist contracts with penalties. Others indicated that it was difficult to use penalties for contracts for hired experts, presumably because of challenges associated with the lack of objective evaluation criteria. And, as discussed above, penalties for undesirable performance outcomes may not be appropriate when performance can be affected by exogenous factors, such as buyer-supplied inputs or the buyer's usage of aircraft. One buyer asserted that it is not cost-effective to collect the detailed data needed to support penalties in this last case.



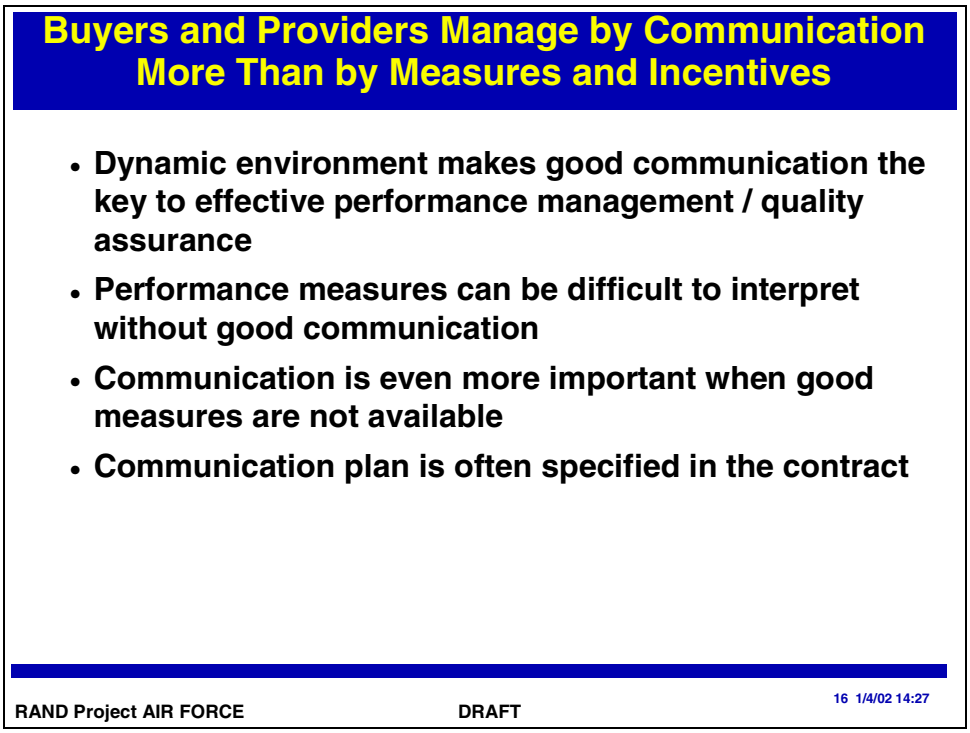
INFORMAL INCENTIVES ARE POWERFUL

We did hear from many of our interviewees that the benefits of a good company reputation provide a strong informal incentive for meeting and exceeding buyer expectations. Providers and buyers said that a good reputation could lead to increased business opportunities. The OEM buyer that hires special experts said the individuals recognize that performing well on one contract can lead to future demand for their services in other parts of the buyer's organization.

Similarly, "preferred provider" status for one of the buyers in our sample may be achieved by delivering superior performance consistently over time. Preferred provider status may increase that buyer's demand for their services.

In addition, the third-party provider of comprehensive aircraft maintenance and modification services told us that meeting or beating schedule allows it to increase its capacity for work. If it can move aircraft through its facility faster, it can contract for more workload and thus

increase profits. Therefore, it is internally motivated to meet or beat the schedule.



BUYERS AND PROVIDERS MANAGE BY COMMUNICATION MORE THAN BY MEASURES AND INCENTIVES

In each of our interviews, buyers and providers stressed the importance of open, frequent communication in managing the performance of engineering support services contracts.

One provider said that performance metrics alone are not useful for aircraft maintenance services. Communication adds value to metrics by helping both buyer and provider understand and reach agreement about what is driving performance and how the provider can better meet the buyer's needs, particularly when exogenous factors can influence service outputs, as discussed earlier. Communication becomes even more important for those services that are difficult to measure through traditional maintenance metrics, such as special engineering studies and contracting for experts.

Two providers and one buyer that we spoke with include details of how the buyer and provider will communicate in their contracts. Another

provider currently does not include this information in its contracts; however, it expects buyers to request this in the future, given the strategic importance of the communication plan to successful service performance.

COMMUNICATION STRATEGY IS TAILORED TO THE SERVICE, EXPERIENCE LEVELS, AND RELATIONSHIP

The examples offered during our interviews make it clear that buyers and providers of engineering support services tailor their communication strategies to the characteristics of a particular contract, including the type of service, the experience of the buyer or provider, and the relationship they share. However, in spite of the diversity in strategies, there appears to be a general pattern in communication approaches.

Firms in our sample stressed the importance of communication early in the purchasing process, even before the contract is in place, to ensure that the provider understands the buyer's needs and expectations. One buyer advocates that both parties write down all of their assumptions relating to the workload. For example, will the buyer provide engineering drawings or other information? What materials will be furnished by the provider? For services such as data entry or engineering drawings, we heard from this buyer that it meets with its providers to inspect their initial work (i.e, prototype). This meeting is written into contracts, and it saves them from heavy quality assurance work throughout the rest of the contract period.

Once the work has begun, buyers and providers communicate frequently to share information and to track progress. These interactions typically happen daily or weekly and may occur in person, in writing, or by phone.

One provider communicates weekly with its buyers for engine maintenance until the last three weeks of the 90-day maintenance cycle. Then they begin communicating more often to ensure that the engine maintenance stays on schedule. This is written into this provider's contracts. When analyzing a buyer's engine performance to predict future maintenance needs, this same provider collects engine data daily from the buyer.

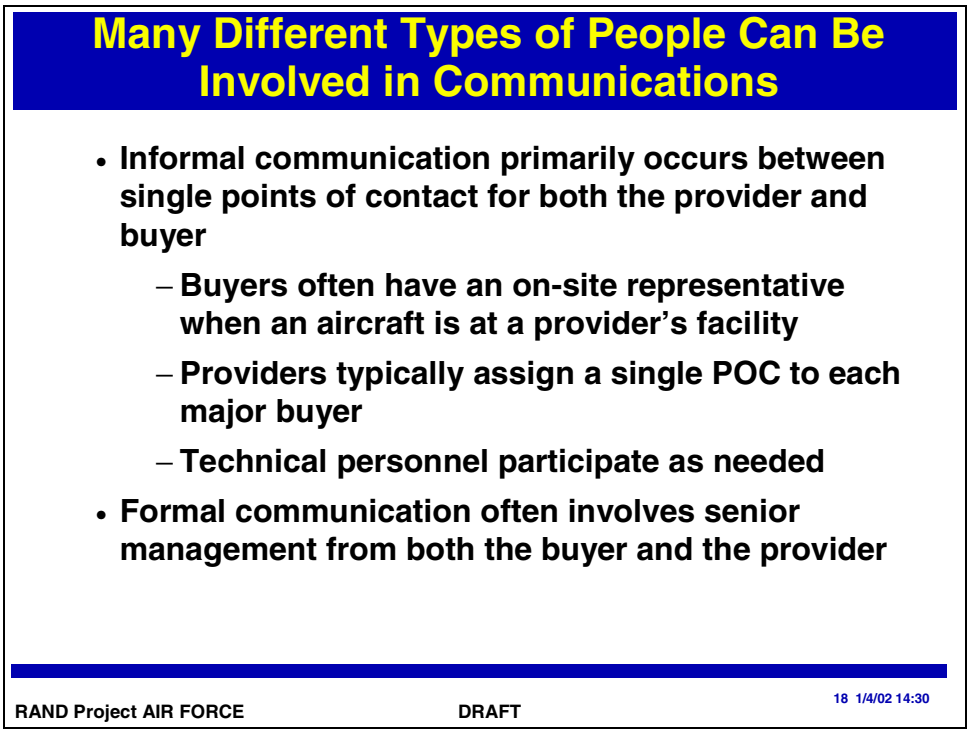
Another provider told us that the frequency of communication depends on whether the workload involves having a buyer's aircraft at its facility. For modification and maintenance services that require having an aircraft on-site, the provider communicates daily with the buyer. Due to enormous pressure to complete the workload on time, the provider needs prompt feedback from the buyer about issues that arise during the course of the work. This provider gives each of its buyers a daily progress report, consisting of status reports from each of the groups working on their aircraft, including engineering. These status reports are generated electronically by the provider's tracking software that monitors the workload schedule. When designing modifications (without an aircraft on-site), this provider gives the buyer written and verbal reports of progress on a less frequent basis. However, when the aircraft arrives for installation of the modification, the frequency of communication increases to a daily schedule.

One buyer told us that the frequency of interaction depends on the levels of experience (related to the type of service purchased) of the buyer and provider and a buyer's experience with the provider in the past. This buyer uses only "key" providers for special analyses of problems with parts and meets weekly with them to discuss findings of all their analyses.

This same buyer told us that when hiring an expert to temporarily work on-site for a special project, informal performance feedback occurs on a daily basis as the expert interacts with the buyer's staff.

In addition to frequent, informal interactions, buyers meet with their providers periodically to conduct comprehensive performance reviews. These reviews typically occur on a monthly, quarterly, or bi-annual basis, depending on the type of service and the degree of trust between the buyer and provider.

Buyers and providers have formal agendas for these meetings that include a progress report on work that occurred since the last review, a discussion of any new issues that have arisen since the last meeting (this can involve lots of technical details), any administrative issues associated with the contract, the buyer's expectations for the coming period, and action items to be addressed during the coming period. One provider told us that the buyers it works with include requests for these meetings in their contracts.



MANY DIFFERENT TYPES OF PEOPLE CAN BE INVOLVED IN COMMUNICATIONS

Providers of engineering support services typically designate single points of contact, sometimes called program managers, to be their primary representatives when interacting with buyers. Buyers do the same for their providers; in fact, one provider told us that a buyer representative accompanies each aircraft that comes to its facility. The points of contact are the primary people involved in informal communications. Technical personnel (e.g., experts in component repair or inspections) are brought into these discussions as needed to address specific issues. Buyers and providers may specify the need for these single points of contact in their contracts.

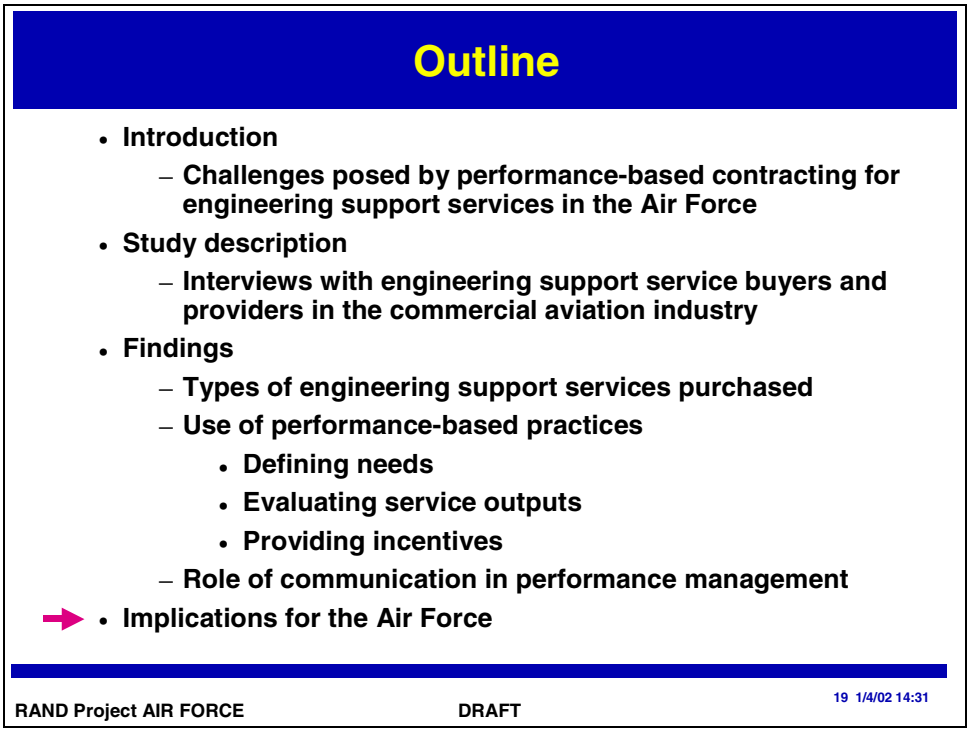
One provider told us that it is difficult to find the right kind of person to be a point of contact. It looks for generalists with some technical expertise and good "people" skills.

Formal performance reviews involve a diverse range of people for both the provider and buyer. The senior leadership of each firm often

participates in these meetings, as well as a variety of specialists relevant to current issues.

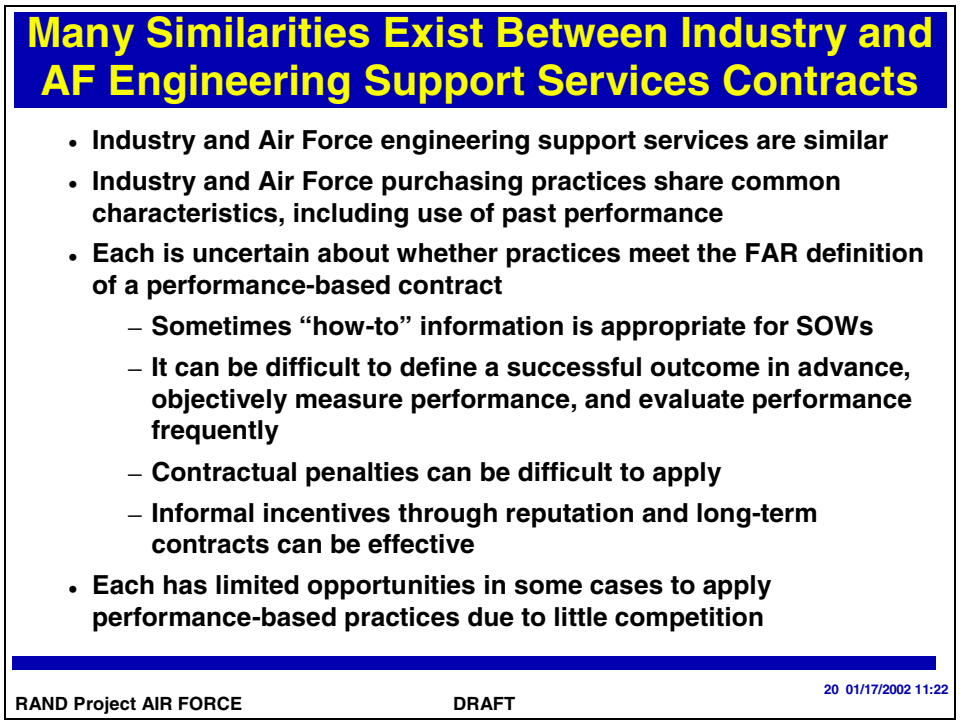
For aircraft heavy maintenance work, buyer participants in formal reviews might include some combination of the following: the vice president and/or managing director of maintenance, an engineering manager, a quality assurance manager, a contract administrator, someone from their legal department, an inventory specialist, and someone from their finance department. Similarly, providers might involve the head of maintenance, the production manager for the part of the facility in which that buyer's work occurs, an engineering manager, a contract manager, and an inventory control specialist.

4. IMPLICATIONS FOR THE AIR FORCE



OUTLINE OF THE REPORT

In this final chapter, we compare the engineering support services purchased in the commercial sector with those purchased by the Air Force. We then draw implications from commercial practices that should help the Air Force better manage the performance of its engineering support service contracts.



MANY SIMILARITIES EXIST BETWEEN INDUSTRY AND AF ENGINEERING SUPPORT SERVICES CONTRACTS

In a companion document (Ausink et al, 2001b), we describe the types of engineering support services that the Air Force purchases to assist in the development, acquisition, and sustainment of its aircraft weapon systems. These services are quite similar to those discussed in our commercial interviews. They cover a wide range of activities including support for aircraft heavy maintenance, engine maintenance, and component repair; design, installation, and support of modifications; developing repairs to address new maintenance or operational problems; re-engineering obsolete parts; software engineering; and evaluation of alternative maintenance strategies.

Given the similarities between types of engineering support services purchased, it is not surprising that our commercial industry sample and the Air Force share similar purchasing practices and uncertainties about whether and how to apply performance-based practices (as outlined by the FAR). Both types of buyers find it difficult to use pure performance-based SOWs because in some cases, the details of how the work is

accomplished are important to the buyer, e.g., due to safety concerns. It can be difficult to objectively evaluate performance consistently over time against known standards of success for some services.[21] In particular, there may not be a clear definition of a successful outcome ex ante or the provider may not control all the inputs to the service, resulting in subjective evaluation. In addition, there may be only a single end product, making repeated, consistent evaluation of performance difficult. Firms in our sample and Air Force buyers expressed similar reservations about applying negative incentives in engineering support services contracts. Each relies heavily on reputation effects and the desirability of long-term relationships to motivate good performance and cost.

Finally, both commercial buyers in our sample and the Air Force face limited competition in markets for some types of engineering support services due to the dominance of OEMs in both commercial and military markets,[22] as well as limited demand and obsolete technologies for some Air Force services. In these environments, both types of buyers may have fewer opportunities to use some performance-based practices, particularly those that directly tie payment to performance.

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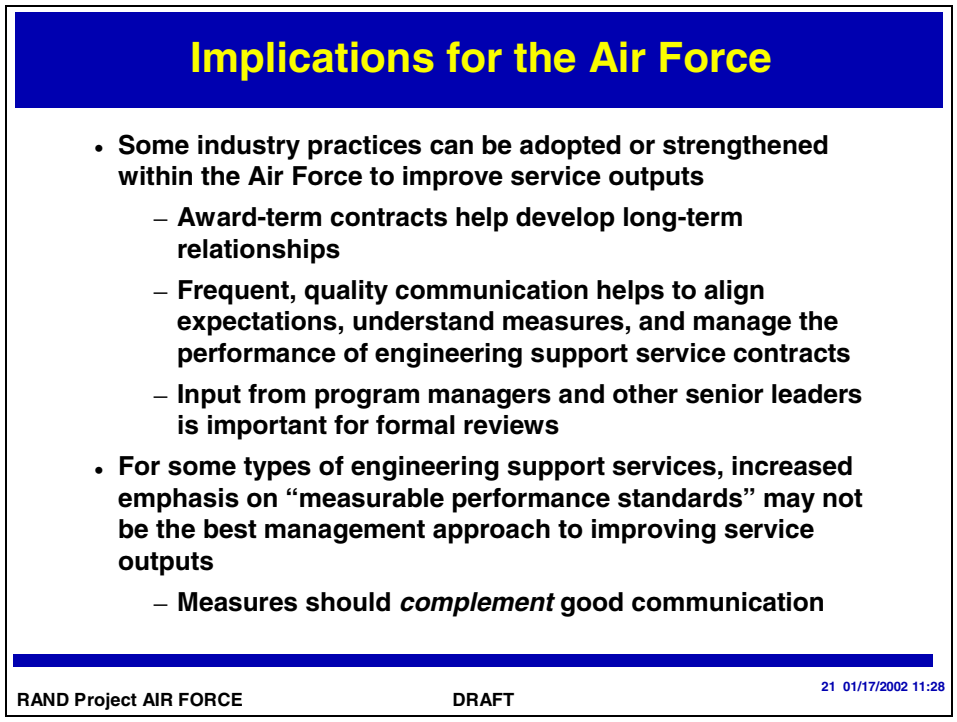
[21] As noted earlier, this is how some Air Force personnel interpret the FAR's requirement for "measurable performance standards."

[22] Also, when contracting with experts, there may be only one person who is qualified.



IMPLICATIONS FOR THE AIR FORCE

As was discussed on the previous chart, the Air Force already employs many of the same practices that commercial firms in our sample use to purchase aeronautical engineering support services. Here, we highlight several commercial practices that we encourage the Air Force to adopt or strengthen in its engineering support services purchases to improve their performance and cost. Commercial buyers and providers value long-term relationships. These relationships are critical for types of services that are difficult to define and measure, and they create opportunities for providers to better identify and serve their buyers' needs. Although the Service Contract Act of 1965 places limits on contract length for some services, the Air Force can use award-term contracts, in which contract length is determined by the provider's performance, to simulate long-term relationships (we anticipate that these will be more effective for competitively-awarded contracts than for sole-source contracts).[23] Our

[23] Two interviewees offered unsolicited comments suggesting that increased contract lengths would enhance the desirability of Air Force service contracts.

recent interviews with Air Force buyers of engineering support services suggest that the Air Force is experimenting with using award term contracts.[24]

The Air Force has opportunities to communicate with potential providers before finalizing a SOW. In addition, the internal Air Force customers that we spoke with at an ALC and Product Center already communicate with their providers of engineering support services at the beginning of contracts (to clarify expectations); they informally discuss performance frequently; and they hold formal reviews periodically to track progress. These practices are clearly reinforced by what we learned from our interviews. One important difference is that it appears the Air Force has traditionally placed greater emphasis on the role of contracting officers in formal interactions with providers and less emphasis on involving the senior managers, although we recently learned that System Program Directors (SPDs) typically interact with major service providers at the Product Center we visited. Our commercial interviews suggest that input from senior leadership is an important part of aligning the provider's actions with the needs of the buyer.[25]

Our interviews with Air Force buyers of engineering support services indicate that they are struggling to figure out how to define and use "measurable performance standards" in managing the performance of these contracts in order to comply with the FAR definition of a performance-based service contract and AFI 63-124. We conclude from our commercial interviews that, for some types of engineering support services, particularly those that are difficult to describe in specific output-oriented terms ex ante or measure objectively, better compliance with a strict interpretation of this part of the FAR may not result in better performance and cost outputs for the Air Force. Rather, the most effective use of performance measures in the performance management process for such services is to complement and strengthen ongoing communication between providers and buyers.

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[24] We have been told that the Air Force and the Office of the Secretary of Defense are currently examining lessons from the Air Force's early use of award term contracts to determine whether they can be used more broadly.

[25] The Air Force recently appointed a Program Executive Officer (PEO) for services who will be involved in large, important service acquisitions. This new position may result in additional interaction between Air Force leadership and service providers.

The Air Force may want to specifically discuss differences in effective performance management techniques for the wide range of engineering support services in its implementation plan for PBSA, as it has done for Advisory & Assistance Services, which have characteristics similar to some engineering support services.

APPENDIX: INTERVIEW PROTOCOLS

This appendix contains the interview protocols we used to guide our interviews with buyers and providers of engineering support services.

Topics for Performance Management Discussion
For Buyers of Engineering Support Services

Background

- Types of engineering support services purchased by your organization
  - As stand-alone contracts
  - Part of broader maintenance contracts
- Primary firms that provide these services
- Types of engineering support services purchased through performance-based contracts

We are interested in how experiences might vary with type of service, contract complexity (e.g., single versus multiple services), and level of success. In the context of specific contracts:

Performance Management Process

- Process used to develop/select the performance management plan
- Any links to the statement of work/objectives
- Details of the performance management plan
  - Tools used to evaluate the provider's performance
  - Communication with the provider
  - How performance information is used by you and the provider
  - How problems are addressed

  - — Incentives to improve performance, reduce costs
  - — Tailoring the performance management plan to the characteristics of the services
- Organization used to manage performance
  - — Personnel involved
  - — How performance management activities fit into their overall duties
- Any documents that describe your approach

Lessons Learned

- How your approach to performance management has changed over time
  - — Process
  - — Organizations and personnel
- Changes you would like to see in the future

Comparing Engineering Support Services to Other Services

- How your approach to performance management for engineering services compares to the approach used for other types of aircraft maintenance-related services

Topics for Performance Management Discussion
For Providers of Engineering Support Services

Background

- Types of engineering support services provided by your organization
- Primary customers/buyers for these services
- Types of engineering support services bought through performance-based contracts

When addressing the topics below, please think about your experiences in the context of specific contracts or buyers. We are interested in how experiences might vary with service type, contract complexity (e.g., single versus multiple services), and level of success.

Performance Management Process

- Process used to develop/select the buyer's performance management plan
- Any links to the statement of work/objectives
- Details of the buyer's performance management plan
    - Tools used to evaluate your performance
    - Communication between you and the buyer
    - How performance information is used by you and the buyer
    - How problems are addressed
    - Incentives to improve performance, reduce costs
    - Tailoring the performance management plan to the characteristics of the services
- People involved in performance management activities, for you and the buyer

Quality Assurance

- Process(es) you use to manage your own performance

Lessons Learned

- How the buyer's approach to performance management has changed over time
- Changes you would like to see in the buyer's approach to performance management
- How the process(es) you use to manage your own performance have changed over time

Comparing Engineering Support Services to Other Services

- How the buyer's approach to performance management for engineering services compares to the approaches used for other types of aircraft maintenance services

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